APS Detector Pool

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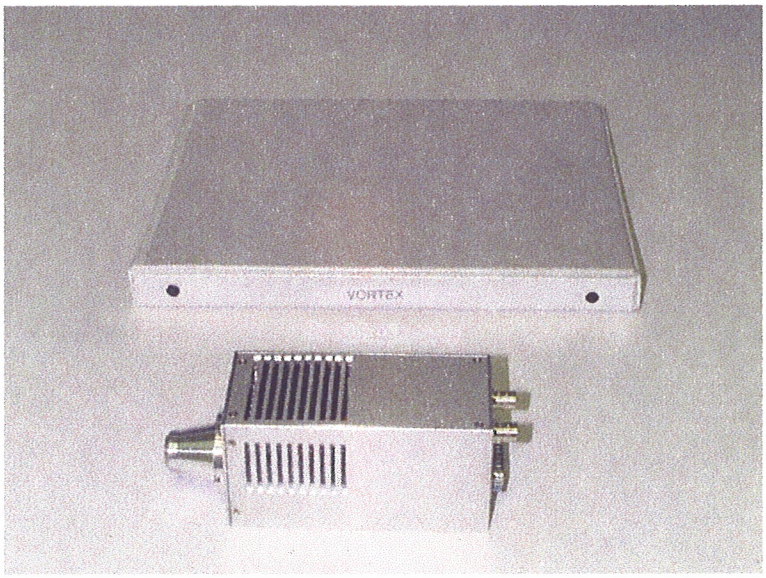
VORTEX

S/N RDT-O-1348-1004
Multi-Cathode X-Ray Detector
Spectrometer System



User's Manual

(Revision 008)

December 02, 2002

This manual and the data herein are subject to change at any time without notification.

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1. General Instructions

- The VORTEX system can be stored at room temperature without any special care, but it is recommended that it be stored in a location with low humidity.

- The beryllium (Be) window in the front of the probe is only 50 microns thick, thus great care must be taken to ensure that nothing comes in contact with it. Cover the Be window with the plastic protective cover when not in use.

- The multi-cathode detector (MCD) package must be placed with the fan side up (solid side with no openings down) during operation time.

- List of delivered items:

  - MCD package
  - Electronic box
  - Main biasing cable
  - Output signal BNC cable
  - VORTEX User's manual
  - Software Installation CD

2. Safety and Precautions

2.1 Detector beryllium window

- The Be window at the front of the detector's probe is extremely thin and fragile. Never touch, jar, or subject the detector window to thermal shock. Do not allow corrosive substances, or water, to be in contact with the window.

- Never allow any object to come in contact with the Be window!

- Beryllium particles are highly toxic. If breakage of a Be window does occur, be sure not to inhale, swallow, or allow such particles to come in contact with skin, open cuts, or eyes. In case of cuts or ingestion, seek medical assistance immediately. In case of window breakage, ship the product to Radiant for repair.

2.2 Detector biases

Be sure that the detector biases are correctly set (see bias specifications pertaining to individual units). Excessively high bias might damage the detector crystal and/or the FET. **When the detector is supplied with the electronic box (which includes the power supply and**

digital pulse processor (DPP)), the biases were set at Radiant and they should not be altered.

2.3 Mechanical shock

The VORTEX system is a relatively rugged device. However, traumatic handling, such as falling onto the floor from a bench height can definitely cause damage. Keep the detector in a safe place during operation and storage to prevent accidental mistreatment.

3. VORTEX System Description

The VORTEX system is comprised of three main parts, as shown in Figure 1: the MCD package, the electronic box and cables.

Figure 1. The VORTEX system.

3.1 MCD package

The MCD package includes the vacuum chamber, which is sealed with a Be window, and the preamplifier box. Inside the vacuum chamber are the MCD crystal , the thermoelectric cooler (TEC) and the first amplification stage: FET. The MCD package weighs 0.8 kg. The MCD package is shown in Figures 2 and 3, with external dimensions shown in Figure 4. The preamplifier box includes the preamplifier, the temperature controller unit, the electrical connectors and the fan.

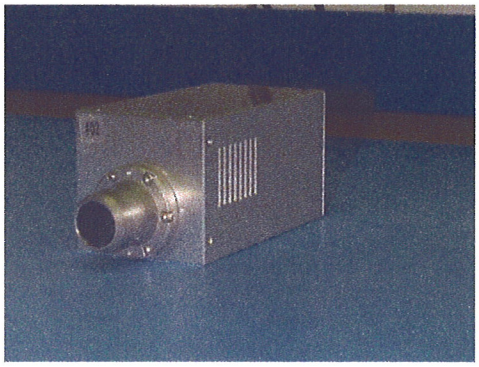

Figure 2. MCD package window side.

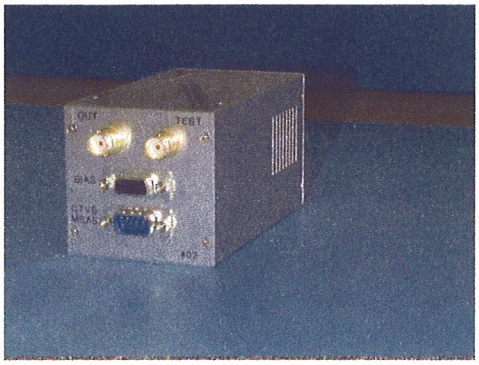

Figure 3. MCD package back panel.

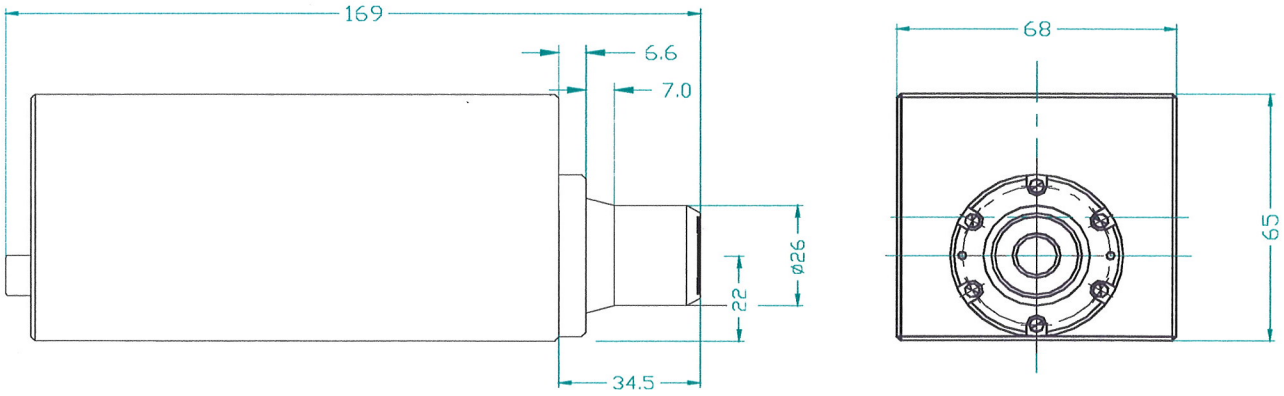

Figure 4. MCD package external dimensions (in mm).

3.2 Electronic box

The electronic box includes four separate voltage power supplies and one dual low voltage linear regulated power supply. The detector power supplies provide biases to the MCD. The linear power supply provides power to the TEC and to the rest of the electronics. A digital pulse processor (DPP) is also included in the electronic box. The front and the back panels of the electronic box are shown in Figures 5 and 6, respectively.

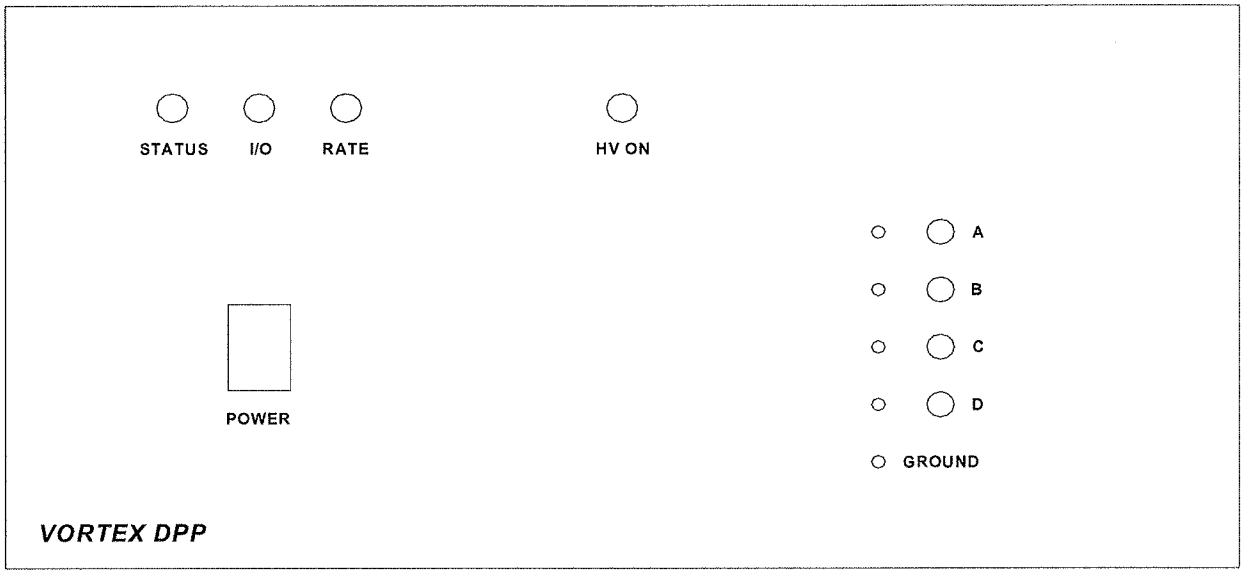

Figure 5. Electronic box front panel.

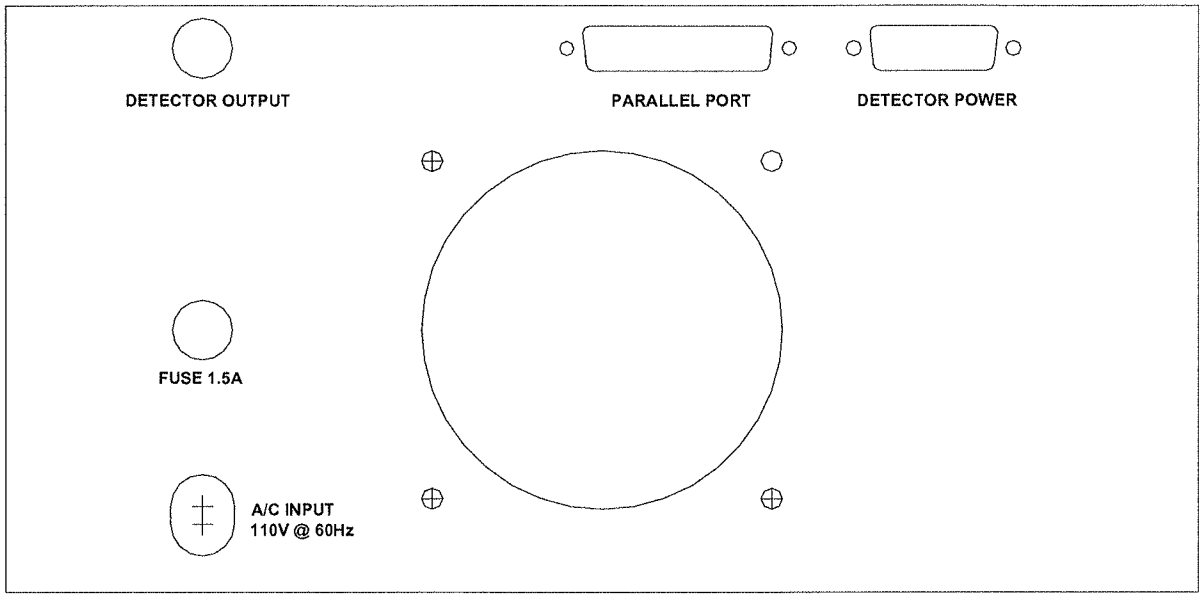

Figure 6. Electronic box back panel.

On the front panel of the electronic box are the: ON/OFF switch, HV ON switch, detector bias regulating points (customers are **not** allowed to adjust biases) and light-emitting diodes (LED) (see Figure 5). The LED status lights on the front panel are as follows:

- **Status (Red LED)**: This LED is lit when the Digital Signal Processor (DSP) has
- detected an error condition; the DSP parameter RUNERROR indicates the source of the error. This LED also illuminates briefly when switching the Field Programmable Gate Array (FPGA) firmware configurations.

- **I/O (Yellow LED)**: Flashes for data transfers.

- **Rate (Bicolor (Green/Red) LED)**: When running with a reset preamplifier, this LED flashes with a 5 ms duration whenever a reset is detected; if the reset rate exceeds 200 Hz, the LED will be "ON" continuously. The color of the LED indicates the relative throughput of the system, as follows:

- If the Output Count Rate (OCR) is greater then 50% of the Input Count Rate (ICR), then the LED is green.

- If $(1/e) < (OCR/ICR) < 0.5$ then the LED is orange (green + red).

- If $OCR/ICR < 1/e$ then the LED is red. (This is roughly the point of maximum throughput).

On the back panel of the electronic box are: "Detector Power", "Parallel Port" and "Detector Output" connectors (see Figure 6). The electronic box dimensions are 250 x 130 x 200 mm^3, and the weight is 5.5 kg.

3.3 Cables

The cables are shown in Figure 7, with the cable edges physically labeled as "main biasing cable" and "out BNC" cable, respectively.

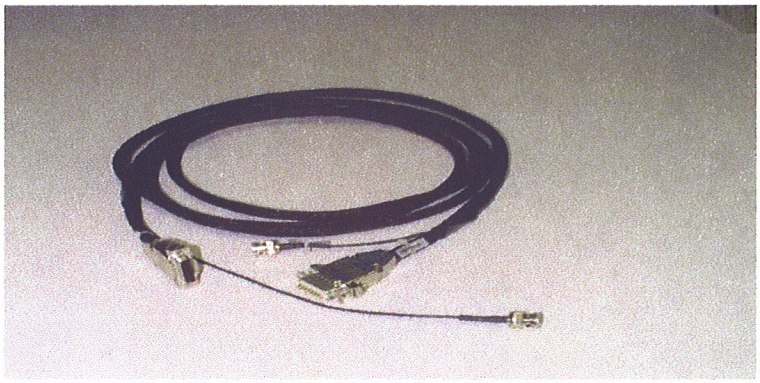

Figure 7. Signal and power cables for VORTEX.

3.4 Preamplifier

The Radiant Detector Technologies preamplifier model AA-1212 is a charge-sensitive preamplifier, which is optimized to work with a transistor-reset FET. The output signal from the preamplifier is a step function with height proportional to the energy of the incident photon (~3 mV per 1 keV photon energy), as is shown in Figure 8. The mV/keV ratio can be modified per customer's request, if required.

With an x-ray source applied, the preamplifier output signal consists of positive steps superimposed on an irregularly spaced ramp of positive slope, as is shown in Figure 9. The negative reset duration is about 1μs. The ramp voltage range is from ~ -1V to ~ +1V.

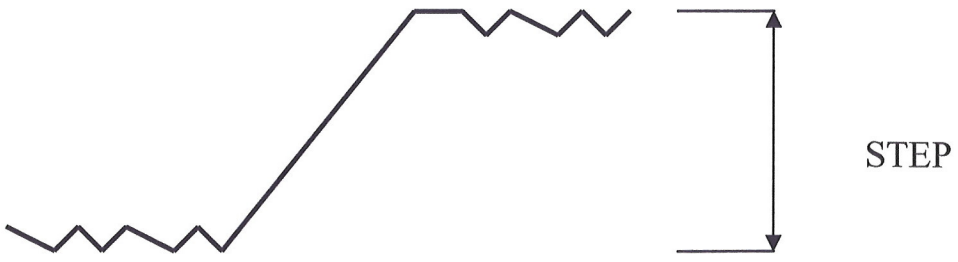

Figure 8. Schematic of preamplifier output step pulse, including noise. Height of the step is proportional to the x-ray photon energy.

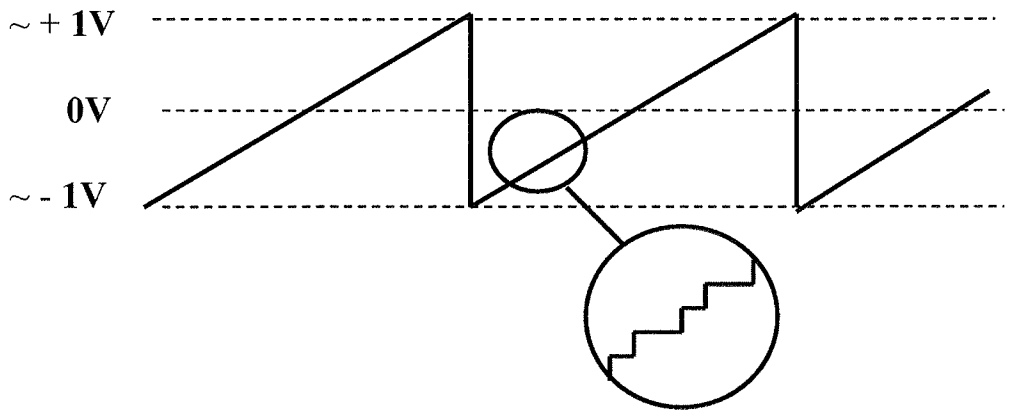

Figure 9. Preamplifier output signal when x-ray source is applied.

The preamplifier connector panel includes four connectors, as shown in Figure 10. The power connector is a DB-9, the output signal connector is a BNC, the test signal connector is a BNC, the vacuum-temperature control connector is a DB-9, and the power connector to the TEC is a DB-9.

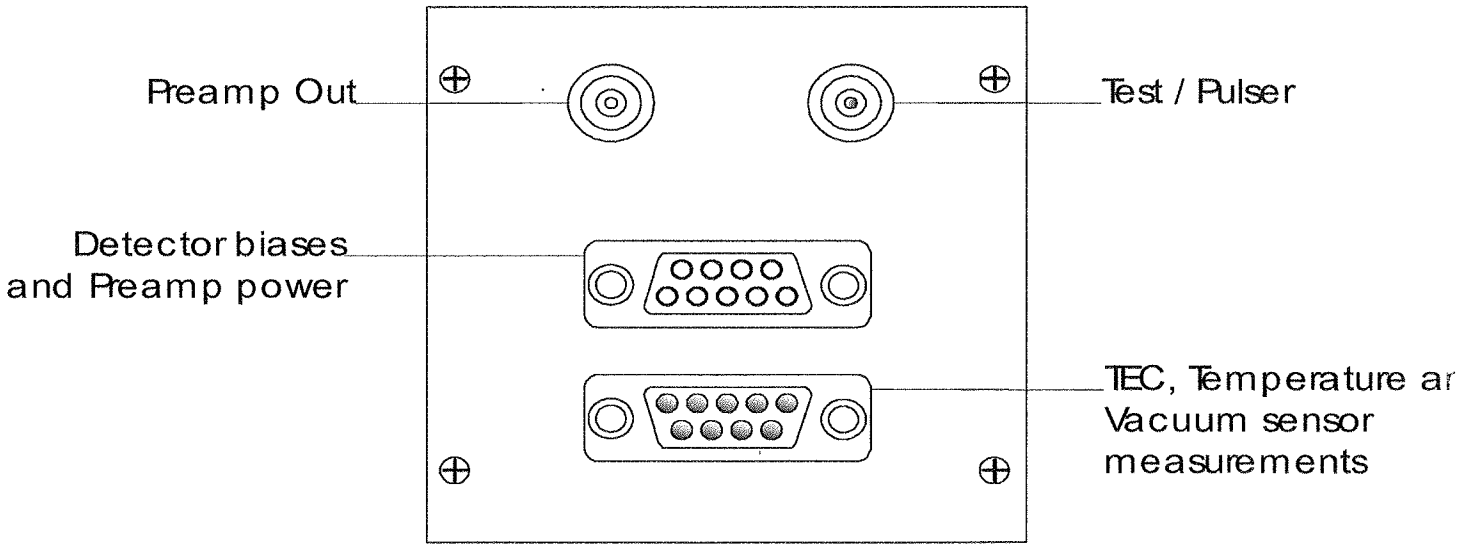

Figure 10. Schematic of connectors on preamplifier panel.

3.5 Software

The Vortex-DPP electronic box comes with the PI-Spec software especially designed to work with Radiant Vortex detector and Vortex-DPP electronics. Using this software, the user can acquire, open/save, export/import spectra or manipulate a spectrum to view its details and evaluate peak resolutions …

To run this software the computer is required to be Pantium III or higher, with at least 64 MB RAM and a 10 GB hard drive. The computer's parallel port must be configured to run in EPP (Enhanced Parallel Port) mode at address 0378H. To do this, run the CMOS setup while starting computer. Note here that ECP mode includes all EPP functions and is thus also acceptable. If not, you will need to change the settings or computer to meet the said requirement. The operating system could be either Windows 98/ME or NT/2000, but Windows 2000 is strongly recommended.

To meet certain customer's needs, we offer another type of software – VTXDLL which, in the form of Dynamic-Link Library, serves as an intermediate layer between the host software and the DPP driver. The objectives are to encapsulate or wrap up the otherwise complicated DPP setup procedures and also to optimize the DPP performance under widely varying conditions. The host software can use it as a shortcut to interface with the DPP without even knowing anything about the latter. This software is available under certain License Agreement.

The software comes with an automated installer. User's manual and instructions are provided in the form of Microsoft Word document, which can be found in the program folder created by the installer.

4. VORTEX Operation

4.1 Setting up the VORTEX for operation

- Connect the appropriate ends of the cables to the connectors shown in Figure 10:

  - main biasing cable connects to the DSub 9 pin connector including: detector bias, TEC and preamplifier power)
  - output cable to "Preamp Out".

- Connect the other end of the cables to the back of the electronic box:

  - DSub 15 pin connector to "Detector Power".

- Connect to a computer:

  - one end of the standard cable with DSub 25 pin connector to the "Parallel Port "of the electronic box
  - other end of this cable to a computer.

- Plug the power cable of the electronic box into the wall outlet.

- Turn the electronic box switch ON.

All detector biases should be preset at Radiant as shown in the following table. Customers should not reset the biases, unless clearly instructed by qualified staff at Radiant.

Detector Bias	Peaking Time	
	Shorter	Longer
A	-12	
B	-67	
C	-102	
D	-185	

4.2 Collecting X-ray spectra

Refer to the "PI-Spec User's Manual", which can be found in the PI-Spec program folder, for instructions on how to collect spectra.

4.3 Powering down VORTEX system

- Turn the electronic box ON/OFF switch OFF.
- The biases to the detector are now off, the Peltier cooler has been turned off, and the detector should reach room temperature within 20 – 30 minutes.

5. Trouble shooting

5.1 The spectrum cannot be acquired

Connect the system to an oscilloscope as shown in Figure 11. Turn on the system as described in section 4.1. Monitor the output of the preamplifier with the oscilloscope.

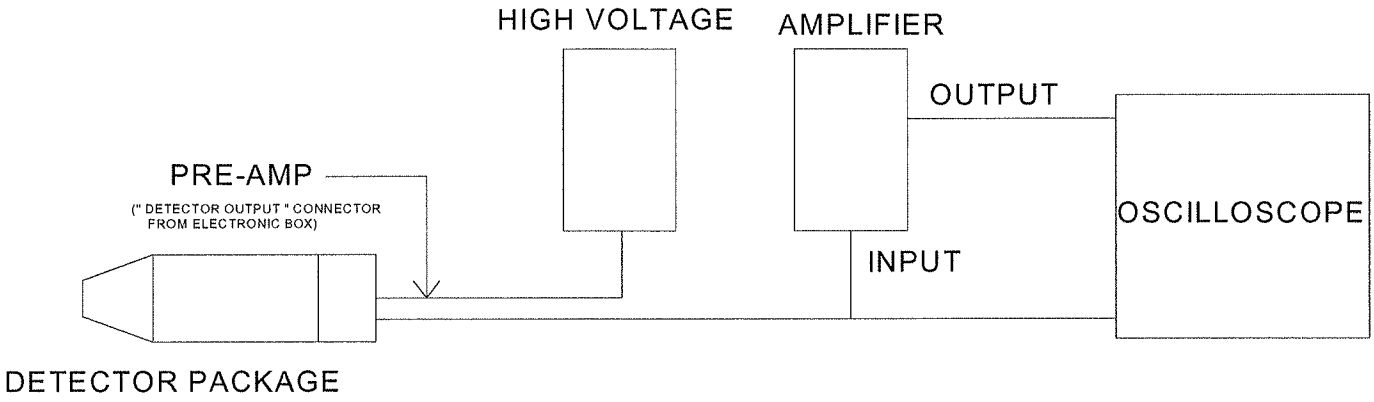

Figure 11. Schematic of cable connections for trouble-shooting

5.1.1 Preamplifier does not ramp up in voltage

If the preamplifier does not ramp up (as shown in Figure 9) but stays at the ~ 0 V < 0V, check the electronic box cable connections to the preamplifier, especially the HV cable. If the cables are connected properly, but still the preamplifier does not ramp up in voltage, then the FET or preamplifier may be defective. (If this is the case, please contact Radiant to arrange to return the detector for repair). Or, for some reason, correct biases are not being supplied to the detector. Then you should contact Radiant staff for consulting.

5.1.2 Preamplifier output is always positive

If the preamplifier output is always positive, and is not resetting as shown in Figure 9, check all cable connections to ensure proper connection and proper bias conditions. If the cables are connected properly, but still preamp output stays positive, detector may not be cold enough.

Contact Radiant staff to arrange to return the detector to Radiant for temperature adjustment. Another reason for this problem may be that the FET and/or preamplifier may be defective and, again, contact Radiant to arrange to return the detector.

5.2 Bad resolution and/or noisy

If the energy resolution is poor, or the spectum is otherwise noisy, ensure that all the cables are properly and tightly connected. If the cables are connected properly, but the resolution didn`t improve, detector may not be cold enough. Contact Radiant staff to arrange to return the detector to Radiant for temperature adjustment. Or, for some reason, correct biases are not being supplied to the detector. Then you should contact Radiant staff for consulting.

6. Technical Support

Please contact Radiant Detector Technologies for technical support or additional information: (818)-709-2468

7. Specification sheet

FWHM @ 5.9 keV @ 12μS peaking time 167eV @ 1,000 cps ICR

FWHM @ 5.9 keV @ 4μS peaking time 172eV @ 10,000 cps ICR

FWHM @ 5.9 keV @ 1μS peaking time 210eV @ 100,000 cps ICR

FWHM @ 5.9 keV @ 0.25μS peaking time 305eV @ 500,000 cps ICR

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